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IN HONOR OF PROFESSOR EINSTEIN[1]

GREETING ON BEHALF OF AMERICAN SCIENTISTS BY DR. KARL T. COMPTON, PRESIDENT OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

IT is a pleasure for me to have the privilege of reeting Professor Einstein on behalf of American ientists. There is first the pleasure of renewing a ersonal contact made with Professor Einstein on the ccasion of his first visit to America shortly after the ar, when he delivered a series of lectures on relativity at Princeton University. Going farther back, here is a second personal connection which Professor Einstein knows nothing about, but which I venture to say has been duplicated by many of my fellow American scientists in some such way as the following.

Some years ago, when my fiancée was debating with herself as to whether she was doing wisely in joining me in the great adventure, we were being entertained in the home of her most admired and respected friend, the pastor of her Methodist church. After dinner this man, who was by nature a poet rather than a scientist, asked me to explain to him in simple language Einstein's theory of relativity, and listened with apparently absorbed interest to my efforts to present this in non-technical language. The next morning he said to my fiancée, "I approve of your young man in all but one respect: he has no sense of humor. I asked him to explain to me Einstein's theory of relativity and he really tried to do it. You are taking a long chance in marrying a man who has no sense of humor." So I suspect every American physicist or mathematician has at one time or another been in a quandary as to whether he should engage upon the hopeless task of an attempted explanation, or whether he should find wisdom in cowardice by stating that he

[1] Address at a dinner under the auspices of theAmeran Friends of the Hebrew University in Palestine, iven at the Hotel Commodore, New York City, on Iarch 15. Besides Professor Einstein, Dr. Compton nd Dr. Shapley, the speakers included Dr. O. C. Kiep, erman consul general; Dr. Solomon Lowenstein, execuve director of the Federation for the Support of Jewish hilanthropic Societies in New York City; James Marhall, a vice-president of the American Friends of the ebrew University in Palestine, and Dr. Nathan Ratnoff, irector of Beth Israel Hospital, in New York City. Sol I. Stroock, chairman of the board of the Jewish Theoogical Seminary, presided. Professor Einstein spoke in erman, his address being translated at its close.

did not understand the theory himself, which was very likely to be true.

The third reason for personal gratification lies in the fact that my first real research work in physics, which was my doctor's thesis at Princeton, constituted, I believe, the first reasonably conclusive experimental proof of the famous Einstein photoelectric equation and through it the correlation of the frequency of light, the contact potential characteristic of any metal illuminated by the light, and the kinetic energy of electrons ejected from the metal under the influence of the light. It was this work which was refined in certain particulars by Millikan four years later to give the most accurate experimental determination of that famous constant of modern physics known as "Planck's constant."

Professor Einstein's interpretation of the rôle of Planck's constant in phenomena which involve the interaction of radiation and matter has been the real foundation of all the marvelous development in spectroscopy and atomic structure, which is the outstanding achievement of physical science in the past twenty years—perhaps because big things are more spectacular than little things, or perhaps because people like to talk and to hear about things which they sense vaguely but do not understand, or perhaps for some other reason which I can not analyze, the public fancy has been taken much more with Professor Einstein's contributions to the theory of relativity than with his contributions to atomic physics and radiation. While the former contributions have been far more extensive, I believe that public opinion should not lose sight of the fact that Professor Einstein's basic contributions to the development of the quantum theory have probably been of even greater influence in effecting the development of the physical sciences than his great general theory of relativity.

Perhaps any attempt to estimate the relative importance of these two great contributions which Professor Einstein has made to twentieth century science is futile because the estimate may be different if gaged on the minute scale of the instantaneous condition of an atom or by the enormous scale of the universe as it is extending through all the ages. This contrast, however, will at least serve to emphasize the great range of interest and of application of the work of Professor Einstein.

It is needless for me to say that all American scientists are delighted with the new arrangement under which Professor Einstein will be regularly one of us. We are delighted not only because of the prestige which his presence will give to our institutions, but also because of the interest and stimulation which his presence will arouse in our young American scientists, who will see in him an ideal which unconsciously beckons them to "go thou and do likewise." Finally, we are delighted with the new arrangement because those of us who have had the privilege of coming to know Professor Einstein personally appreciate him as a person and are glad on personal grounds to have him as an associate. In this welcome we include also the most effective of all his colleagues, Frau Einstein.

ADDRESS ON "THE COSMIC PARADE" BY DR. HARLOW SHAPLEY, DIRECTOR OF THE HARVARD COLLEGE OBSERVATORY

I AM requested to describe the universe of which our guest of honor is a part and concerning which he busies himself at times. I am asked to tell the story of a world that contains electrons, galaxies, space, comets, politics, slush and after-dinner speakers. I am to describe a universe that spreads throughout more than a million, trillion, trillion, cubic light years, that has existed for some thousands or millions of millions of years—and I have for this descriptive job ten minutes, minus the time taken by the introducer. You should pardon me if here and there I am rather brief with minor details. Indeed, I shall consider chiefly the grosser cosmos and not bother much with the intricacies of the atom or the private life of electrons.

As interpreters of the world we do not know how good we are, nor how bad. We must leave to future generations to say just where we went wrong. I suspect that if any attention whatever is paid to the science and scientists of the first third of the twentieth century it will be to the fundamental deductions and to the pioneer observations (crude as they are). I suspect that we are too near the front in this battle of nature's secrets against test-tubes, spectroscopes and mathematical analysis to realize how much we pursue current fads, how enthusiastically we over-interpret fragmentary observations of fragments. But even at this close range we can see the oncoming mortality of practically all current theories, both of the microcosmos and of the macrocosmos. There is an over-population of hypotheses; they crowd and cancel one another. New observations add to the slaughter. Within the past year, almost accidentally, we stumble upon fundamentals like the neutron and the positron, entities that had not been explicitly included in the atomic models and pictures of the preceding years. But brave hypotheses are necessary to guide, transiently; the observations stand for a while; the good measures, in fact, are essentially permanent; and the enthusiasm back of it all, the will to know and the willingness to fumble as we learn to know—they are eternal.

Leaving the fascinating though uncertain world of the atom and the molecule, let us accept matter as

proved though not defined and gaze into the ominous astronomical world.

To picture for you most easily this universe of stars which stretches quite beyond reason, space and time and imagination, let me parade the cosmos before you, bit by bit. You are for the occasion transformed into super-cosmic beings, brought in for this show, let us say, from a place that lies beyond the bounds of our space-time and from an epoch preceding the beginning of time—impersonal spectators, you are looking us over. While you cosmics sit before me, smoking or fiddling with the spoons or thinking or perhaps just sitting, I start the sidereal parade with a waving of nebulous banners and a blare of celestial trumpets; for the first body ushered in is nothing less than Number Three. That is, Planet Number Three—dear old earth herself. On the return trip there will be less trumpeting, I surmise, when Number Three appears. Number Three, ladies and gentlemen, is one of the funniest things I can show you; the only place in the universe, so far as I am aware, where demagogues rule, where man destroys man, where imbecility of various sorts is bought and sold in the open market. It is, however, also the abode of ideals, altruism, reasoning thought.

Numbers One and Two are Mercury and Venus in this numbering of the planets outward from the local star. The star itself, one of thousands of millions, is a hot, radiant turmoil of mixed gases. If our star, the sun, were reduced in scale so that its million-mile diameter is but six inches (about that of this microphone) the planets on the same scale would be the dimensions of coarse sand grains and bits of gravel and of much the same importance. Number Three, a small sand grain, is fifty feet away and plodding its yearly trip about the sun in a circular orbit with astonishing monotony. How we all cling to that rocky fragment, holding on desperately, not physically of course, because gravity takes care of that; but holding on temporally, in time, for just as many turns as possible. Sixty, seventy, eighty whirls, and we let go —that is our portion on this merry-go-round that has already whirled dreamily about the sun a few thousand million times with scarcely any evidence of running down.

The furthermost of the planetary sand grains now known is Pluto, about five city blocks from this microphone sun; to the nearest star neighbor it is some three thousand miles.

But enough of this part of the parade; enough of Number Three with its superficial whiff of atmosphere, splash of ocean and smear of biology. We turn attention to phenomena more fundamental than planets.

A long interval now passes before you cosmic spectators—a parade of nothingness. Interstellar space is passing, the phenomenon, or lack of phenomena, that incites sober men to cosmogony, that leads thoughtful men to strange comments concerning space and time, infinity and eternity.

But look closely and you will see that the emptiness is not completely empty. In every cubic yard of interstellar space are a hundred atoms that have been ejected violently and driven from the hot atmospheres of stars. But these hundred atoms per cubic yard do not alleviate the stark emptiness. There are a trillion trillion times as many atoms in a cubic yard of the atmosphere in this room. Interstellar space is effectively a vacuum.

In addition to the few hurrying atoms and molecules, space is everywhere permeated with the weak radiation of all stars. The light of a thousand million stellar sources pours at the rate of fifteen thousand trillion pulses per second through every cubic inch of interstellar space. And, in spite of this, almost complete darkness prevails. Is it any wonder that scientists dream dreams when they seek to interpret the universe as a whole—its meaning in space and in time?

Coursing also through this pseudo-emptiness are occasional lost planets and comets, and frequently high-speed cosmic meteors, which record themselves as shooting stars when they strike and expire in our earth's protecting atmosphere. We have recently proved at the Harvard College Observatory the prevalence outside our solar system of these minute stony fragments from past explosive catastrophies. The speeds of meteors frequently exceed a hundred miles a second. Their significance in cosmogony is deep, their source is obscure and intimately tied up with the origin of the phase of the world that now exists. But numerous as they are, they do not relieve the essential vacuity of space.

The procession moves on and we pass before you stars of all sorts—giant spheres, a million times the volume of our own star; dwarf, shrunken suns that appear to be perishing from exhaustion of their radiant energy; stars of various temperatures and stages of evolution; double stars, triples, stars in groups, clusters and clouds. You will note that the chemistries are much alike from type to type, that the chemical elements of stars are the same as the elements of the flying meteors and of the crust of the earth. You will note also that regardless of the region of space or interval of time from which I select the sample stars for this procession, the same gravitational principles operate, the same laws of radiation prevail as those familiar now in the solar system—a common universal chemistry and common laws.

As the procession of stars goes by we do not see

any little planets or moons. They may be there, though invisible, but after all that's not an important matter.

The parade goes on, and now appear the nebulae, some bright and some dark, the most spectacular part of the pageant. For the bright nebulae are of weird form, of vast dimensions, agglomerations of radiant gases and of meteoric grains of sand and iron. And the dark nebulae are impressive because of the secrets they conceal by hiding great portions of the universe; impressive also because they originate, possibly, from exploded planets and stars or from earlier disrupted universes. Are they the materials from which eventually new stars and galaxies will arise?

In the procession that I have to this point passed before you were, first, the minor bodies, such as the planets and comets of the solar system. Next came a sample of interstellar space and its thin content of radiation and of stellar débris. Then the stars, singly and multiply, and the diffuse nebulosity, bright and dark, which may be star plasma or the wreckage of stars or, in a long-time universe, may be both.

We now rise to a higher order in the pageantry that passes. Here are not stars but great systems of stars which we call galaxies or, if they are remote and therefore hazy and indistinct and unresolved, we misname them nebulae or nebulous stars. Also in great variety the galaxies go by, some gigantic, some so dwarfish that they may contain but a few thousand million ordinary stars; some are spherical, most of them flattened, and more than half show that their population of stars is arranged in spirals.

These common spiral galaxies occur singly, doubly, in close confused triples and multiples, and in clusters and in great clouds and streams, which we term super-galaxies, sometimes millions of light years in extent.

A few of these galaxies have been observed with the spectroscope. There is a startling red shift of their spectral lines. Interpreting that red shift in the normal way as a recession of the galaxies, we are led to the concept of the expanding universe, a scattering of the galaxies, a lowering of the density of matter in space. We are led to the speculation that the origin of the present phase of the universe occurred not much more than three thousand million years ago, disturbingly recent to the orthodox astronomer. We are led to remarkable preliminary speculations connecting the theory of relativity with the recession of galaxies, from which we deduce evidence for a spherical finite world.

Finally, at the end of the procession, we try to exhibit the metagalaxy, the all-inclusive universe of galaxies; but the display is poor because, with a reach of only a hundred million light years, our sample possibly is misleading. We note, however, three conspicuous features:

(1) Exceeding non-uniformity in the distribution of matter.

(2) No evidence that our own galaxy is significantly placed with respect to the millions surrounding.

(3) No suggestion that in our deepest exploration we anywhere approach a boundary to the universe.

The cosmic parade is finished. I now retransmute you from super-cosmic beings to primates on Planet Number Three; and I leave with you the thought that, although in the last twenty years our knowledge of the sidereal world has more than doubled, the list of things we want to know has trebled or quadrupled, leaving us relatively more ignorant than heretofore, but making us also keener than ever to attain that spiritual satisfaction that only the struggle to comprehend can give.

ADDRESS BY PROFESSOR EINSTEIN

LET me first give expression to my delight and gratitude for the wonderful reception which has been given to me in this festive hall by so prominent and distinguished an assemblage. But this honor, at so serious a time, would depress rather than exalt them, if it were not for the redeeming consciousness that, by this visit, I could be of service to two institutions which are very close to my heart—the University in Jerusalem and the Jewish Telegraphic Agency.

Let us fix our eye first upon Palestine. It should fill us with pride and joy that our work of upbuilding is made possible, to a great extent, by liberal gifts, and that those whose hearts and hands have achieved this upbuilding have imposed upon themselves a hard lot in order to serve a high ideal. We may therefore say that this work rests upon the shoulders of the best of our people. It is because of this that it has until now wonderfully withstood all the difficulties of trial and affliction and stands to-day more sound and promising than many settlements in lands more favored by nature. If the speed of growth does not satisfy some of our hot-headed and impatient brethren, let us remember that in social structures as well as in organisms the most worth-while are not those which grow and mature most rapidly.

As old as the plan of the upbuilding work itself is the plan for the establishment of the Jewish University in Jerusalem. This is not to be wondered at in a people who have for nearly two millennia treasured as the highest good the pursuit of the spiritual for its own sake. So it was that soon after the war, on one of the most beautiful spots of the country, the university was founded. Originally, it was not intended primarily as an institution of instruction but as a center of research.

The sympathetic interest which this work, together with the library in Jerusalem, had aroused among intellectual Jewish elements was universal and strong, and there arose great-hearted givers who made possible the realization of the university, in which efficient and devoted scientists were already busy and are still busy. In spite of many diseases of infancy through which such a new institution, exposed to so many varying influences, must pass, the university has to-day already demonstrated its vitality and the Palestine work can not longer be thought of without it.

With gratitude may be mentioned here Mr. Felix Warburg, and not less the American Jewish Physicians' Committee. The Jewish people will never forget their help on behalf of the university.

I am convinced that it is especially fortunate for the university that Mr. Weizmann has decided to put his abilities at its disposal and to found and direct a department for agriculture. His great experiences in the field of chemistry and administration and, last but not least, his rare knowledge of men will be of great usefulness for the university; his fascinating personality will also lend it new attractiveness. I believe in a sound and beautiful development of the institution in the next few years.

The significance of the University in Jerusalem for the Jewish people will be heightened by the fact that the Jews in eastern Europe are being barred from the sciences and the practise of scientific professions. In the course of the years, I have heard and read much that is sad regarding this spiritual misery, and, it is, unfortunately, not easy to say where the western boundary of this eastern Europe is to be sought. In any case, this boundary is indefinite and the psychical misery of the Jews is not lighter than the physical.

Many talented Jews are lost to culture because the way to learning is barred to them. It will be one of the foremost aims of the University in Jerusalem to alleviate this misery. May it contribute to the attainment by the Jewish people of a spiritual and moral height which will be worthy of its past.

The task of the Jerusalem University just referred to leads us to our second chief object, the Jewish Telegraphic Agency. The Jewish people belongs among the most oppressed national minorities; it is a national minority in all places whither its wandering staff has led it. It belongs among those peoples who must suffer to an especially high degree from the prevailing disease of an exaggerated nationalism. This nationalism is a grave danger for the entire western civilization, which at one time had its origin in Greece; behind it are powers inimical to life. To combat it is the inescapable duty of every well-intentioned and perceiving person of our time.

We Jews have to suffer from this scourge not only as one of the oldest branches of our western culture, but also as a people which is scattered over the entire world and is, therefore, regarded as nationally alien everywhere. In order not to be crushed, at this time, by inimical powers in its environment, this people requires living cohesiveness, solidarity.

Such a living cohesiveness is possible only if we are kept objectively informed about the lot of the Jews in all countries. This, the Jewish Telegraphic Agency has been doing for a decade and a half in a graphic and objective manner, and, in so doing, it has performed an important service to the Jewish people. To support this private enterprise in times of economic crisis is a self-evident duty of self-preservation. It is also part of the struggle for justice, whose significance transcends merely Jewish interests themselves. As director of the Jewish Telegraphic Agency, Mr. Jacob Landau has earned commendation which we joyfully acknowledge this day.

As I, myself, am no nationalist, the meaning of a people, in my opinion, lies in this—that it achieves something for humanity. I shall not bring up the question regarding the Jewish people here and now, but will only emphasize that this point of view must always be our guide in everything Jews undertake. The only worthy attitude of an individual as of a nation is this—to serve a greater whole and to strive for improvement and ennoblement.

OBITUARY

OLIVE M. LAMMERT

MARCH 5, 1894–OCTOBER 9, 1932

OLIVE M. LAMMERT, professor of chemistry at Vassar College, graduated from Vassar in 1915. From the time of her graduation until her death, except for two years of graduate work, she was a member of the Vassar department of chemistry. In 1919, as Sutro fellow from Vassar, she began graduate work at Columbia University; she received the doctorate in 1924.

The topics of her series of researches (presented in ten journal articles with J. L. R. Morgan) were a logical consequence of the initial one, the study of the effect of light upon the electrical conductance of solutions of the alkali halides in acetophenone. Professor Lammert's appreciation of the increasing importance in many fields of the determination of hydrogen-ion concentrations led her to organize at Vassar a course on this subject which is probably unique and has become an important unit in the work offered by the department. For the past six years she has been collaborating with J. L. R. Morgan in

preparing a reference text-book on physical chemistry.

The independence of thought and the initiative shown in her great creative ability, her broad philosophical outlook, her persistence in carrying out detailed work, her highly developed experimental skill and her great resourcefulness made her work that of real genius. In all she did her boundless enthusiasm, her deft precision and her clarity of thinking were such that, as a former student writes, "she will always be more than a teacher—she will be the inspiration that carries us on." To her rigorous teaching she brought the gay touch of a keen sense of humor and the charm of a rare personality, the combination making "her classes memorable."

Her keen insight and balanced judgment made her a trusted, valuable member of important committees. These same qualities, together with her constructive sympathy and understanding, brought students to her constantly for aid in personal problems as well as in chemistry, and she, whose generosity was unlimited, was never too busy to help them, giving to many "one of the best parts of college life."

For all who knew her the words of Professor Reed, whose beautiful tribute appeared in the *Vassar Quarterly,* are true: Professor Lammert's death "has overwhelmed us at the college with a sense of tragic loss. She was brilliant, and gay and magnanimous; her presence radiated a sort of energy that made us all glad to be alive; she had a warm heart overflowing into actions of unforgettable kindness; and she was only thirty-eight."

A clear thinker, an indefatigable searcher for extreme precision, an exceedingly well-informed scientist and a marvelous manipulator, Professor Lammert is indeed a loss to physical chemistry.

MARY LANDON SAGUE

VASSAR COLLEGE

RECENT DEATHS

DR. ARTHUR HOLLICK, paleobotanist of the New York Botanical Garden, died on March 11, at the age of seventy-six years.

JOHN L. STONE, professor emeritus of farm practise in the New York State College of Agriculture, Cornell University, died on March 8, at the age of eighty-one years.

RALEIGH DUDLEY MORRILL, associate professor of experimental engineering at New York University since 1926, died on March 11. He was forty-eight years old.

DR. HENRY GEORGE MEHRTENS, acting dean of the Stanford University School of Medicine, died on February 28, after a short illness from heart attacks. He had been connected with the Stanford faculty since 1915, and acting dean of the Medical School since the beginning of the present college year following the retirement of Dr. William Ophüls. Dr. Mehrtens received his medical training at Stanford and had been house physician in the Lane Hospital in San Francisco since 1915. He was professor of medicine, specializing in neuropsychiatry. Dr. Robert E. Swain, acting president of the university, said: "The death of Dr. Mehrtens is a very serious loss to Stanford University, to medical education and to medical science. An accomplished scientist and scholar at an early age, he was an effective teacher, and during the present year as acting dean of the university's medical school has devoted unselfish and effective service to its work."

HURON H. SMITH, curator of botany in the public museum of Milwaukee, Wisconsin, was instantly killed when the automobile in which he, his wife, and the father and mother of Mrs. Smith were riding was hit by a Milwaukee road passenger train at a crossing one half mile south of Glenview, Ill., early in the evening of February 25. Mr. Smith had been curator of botany at the public museum in Milwaukee since 1917. He was recognized as an authority on Indian life, on flowers and trees. He was made a member of the Menominee tribe of Indians several years ago. E-we-ona-ginka, medicine man of the Winnebagos, confided all his closely guarded secrets to Mr. Smith because he could find no young man of the tribe worthy to be his successor. Mr. Smith was a member of the Wisconsin Archeological Society, the Milwaukee Horticultural Society and honorary member of the State Forest Association. He was a fellow of the American Association for the Advancement of Science. He obtained his arts degree from DePauw University in 1905 and was an instructor in dendrology at Cornell University from 1905 to 1907 and obtained his master's degree from that institution. He was a tree specialist and dendrologist with the Field Museum, Chicago, from 1907 to 1911, and assistant curator of botany from 1911 to 1917.

SCIENTIFIC EVENTS

BOULDER CANYON LAKE WILD LIFE REFUGE

THE great artificial lake to be created by the Hoover Dam on the Colorado River will become a refuge and breeding ground for wild birds and animals under an executive order signed by President Hoover on March 3. The new reservation will be known as the Boulder Canyon Wild Life Refuge. Superimposed on part of the land and water area withdrawn for the Boulder Canyon project for river

regulation, flood control, irrigation, domestic water uses and power development, the new wild-life refuge will cover a total of about 620,000 acres, approximately 132,000 acres of which will be a vast artificial lake on that part of the Colorado River, in Arizona and Nevada.

Administration of the refuge will be by the Department of Agriculture, through the Bureau of Biological Survey, subject to use by the Department of the Interior for its primary purposes. Paul G. Redington, chief of the Bureau of Biological Survey, in a statement issued on March 7 said that the flooded area will be wholly in the Lower Sonoran Life Zone, with the hot summer and mild winter climate of the mosquito and creosote bush country providing a breeding ground for many interesting birds and mammals of the southwestern desert region, and a winter resort for many northern migratory birds. Mr. Redington writes:

> It was a paradise throughout the year for Arizona quail, roadrunners, thrashers and other birds. In winter, swans, snow geese, many ducks, some shorebirds, waders and a host of other smaller migrant birds found a congenial resort in the Virgin and Colorado River Valleys, the natural outlet of the Great Basin. When this area becomes a great lake, with curving bays and deep inlets cutting back into side valleys and gulches, it will again be a great attraction for northern waterfowl and provide cover and food for the resident birds that are pushed back from the middle of the valley.
>
> The refuge will be an oasis in an otherwise arid country on one of the southward bird-migration routes, a way station from Klamath Lake Refuge, Oregon, to the Gulf of California. The Federal Bear River Refuge, on Great Salt Lake, lies 400 miles northeast, the Salton Sea Refuge is 225 miles to the south, and the Fallon Migratory Bird Refuge in Nevada is about 350 miles northwest. The new refuge, therefore, should prove a valuable resting spot and winter resort for many waterfowl that now seek congenial waters beyond our southern border.
>
> Beavers, muskrats and otters will be the main local aquatic mammalian fauna, but the protected area will also provide homes for antelope-squirrels and chipmunks, as well as for little desert foxes, gray foxes, raccoons, and other interesting animals of the region.
>
> The value of this new refuge in the Southwest is greatly enhanced by its geographic position, and a more favorable place for preserving and enjoying the close presence of aquatic and other wild life could not be found in the whole region. Within the new refuge it is unlawful to hunt, trap, capture, wilfully disturb or kill any wild animal or bird of any kind whatever, or to take or destroy the nest or eggs of any wild bird.

THE MUSEUMS OF ARCHEOLOGY AND GEOLOGY AT THE UNIVERSITY OF KENTUCKY

The University of Kentucky reports the opening on March 7 of two museums on the campus, the Museum of Archeology and the Geological Museum. The archeological museum, which is housed in a building of its own, will be opened to the public each Tuesday and Thursday afternoon from two to four o'clock, and the geological museum will be open daily.

The archeological museum was prepared with the purpose of depicting prehistoric human life in Kentucky, and has reproduced ancient graves, ossuary pits and other evidences of prehistoric races in the exact manner in which they were unearthed. Horace Miner, senior student, has been appointed curator under the supervision of Professor W. S. Webb, head of the department of anthropology and archeology.

The archeological museum occupies a small building which faces the side of the administration building and which was formerly occupied by the library. The basement floor is devoted to offices and a large lecture room for class work, and the museum proper is entered through a wrought iron grill, designated and executed in the College of Engineering under the direction of Stephen Saunier, instructor in the forge shop. It has as its motif Indian artifacts, such as shells, arrow heads, pipes and other accoutrements, which have been reproduced in the grill work in an intricate pattern.

The whole outlay of the museum tells a story of prehistoric life in Kentucky. Some of the features are the burials which have been reproduced with skeletons, artifacts and even the earth deposits around the burial ground. Professor W. S. Webb, head of the department, has placed there his private collection.

The geological museum is on the second floor of the administration building and was arranged by the department of geology in conjunction with the Bureau of Mineral and Topographical Survey. In it an attempt has been made to emphasize the rocks and minerals of economic and commercial importance in the state, together with other features of commercial and scientific interest.

Professor A. C. McFarlan is director of the Bureau of Mineral and Topographical Survey and David Young is curator of the geological museum. In this exhibit much attention has been paid to the Kentucky caves and a representation of cave material and typical cave phenomena has been prepared. Fossils of the animals and plants which lived in this region in past geologic ages and whose remains are now found preserved in the rocks of the state are well represented.

REQUIREMENTS FOR THE LICENSE OF MEDICAL STUDENTS IN NEW YORK STATE

Requirements of the New York State Education Department for the admission of American or Euro-

pean medical students studying abroad to New York medical licensing examinations have been announced by Dr. Ernest E. Cole, acting commissioner of education. These requirements are in harmony with regulations recently promulgated by the Federation of State Medical Boards of the United States. The federation has announced that students proposing to study medicine in Europe will be subject to the following regulations for admission to the various state medical licensing examinations:

1. No American student matriculating in a European medical school subsequent to the academic year 1932–1933 will be admitted to any state medical licensing examination or to the examination of the National Board of Medical Examiners, who does not, before beginning such medical study, secure from a state Board of Medical Examiners or other competent state authority, a certificate endorsed by the Association of American Medical Colleges or the Council on Medical Education and Hospitals of the American Medical Association showing that he has met the premedical educational requirements prescribed by the aforementioned associations.

2. No student, either American or European, matriculating in a European medical school subsequent to the academic year 1932–1933 will be admitted to any state medical licensing examination, or to the examination of the National Board of Medical Examiners, who does not (a) present satisfactory evidence of premedical education equivalent to the requirements of the Association of American Medical Colleges, and the Council on Medical Education and Hospitals of the American Medical Association, and graduation from a European medical school after a medical course of at least four academic years, and (b) obtain a license to practise medicine in the country in which the medical school from which he is graduated is located.

NEW MEXICO MEETING OF THE SOUTHWESTERN DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE thirteenth annual meeting of the Southwestern Division will be held from Monday to Thursday, May 1, 2, 3 and 4, at Las Cruces, New Mexico. The host institution will be the New Mexico College of Agriculture and Mechanic Arts, the post office address of which is State College, New Mexico.

Officers of the division are: Charles T. Vorhies, University of Arizona, *president;* F. E. E. Germann, University of Colorado, *vice-president;* Edwin F. Carpenter, Steward Observatory, University of Arizona, *secretary-treasurer.* Officers of the New Mexico Association for the Advancement of Science are: S. B. Talmage, *president,* New Mexico School of Mines, Socorro; H. C. Graham, *vice-president,* State Teachers College, Silver City; H. G. Fisher, *treasurer,* New Mexico Museum, Santa Fe; E. R. Harrington, *secretary,* High School, Albuquerque.

The general meetings will include the opening session on Monday morning; a symposium on problems relating to erosion, on Tuesday evening; and the annual banquet at which the retiring president of the division will deliver his address, on Wednesday evening. In addition there will be a luncheon symposium devoted to the historical interest of the region, in Old Mesilla, near Las Cruces, site of the signing of the Gadsden Purchase of 1853. The John Wesley Powell Lecture, now partially endowed by recent vote of the executive committee, will be delivered, probably on Monday evening, May 1, by Aldo Leopold, consulting forester, of Madison, Wisconsin.

Las Cruces lies at an elevation of 3,800 feet on the El Paso-Albuquerque branch of the Santa Fe Railroad, 40 miles north of El Paso.

Excursions and entertainment are being planned by the local committee under the chairmanship of Professor D. S. Robbins. Thursday, the last day of the meeting, has been set aside for the excursions. The points for which visits have been definitely planned are (1) White Sands, a large area of drifting dunes of gypsum sand, about 40 miles from Las Cruces; (2) the Jornada Experimental Range, about 23 miles from Las Cruces, and (3) El Paso, 40 miles southward, for its mining and metallurgical industries, its cement and electrolytic copper plants, several oil refineries, and, across the border, Juarez.

SCIENTIFIC NOTES AND NEWS

THE bicentenary of the birth of Joseph Priestley occurred on March 13. He was born in Yorkshire and came to the United States on June 4, 1794, living in Northumberland, Pennsylvania, until his death on February 6, 1814.

DR. HUGO DE VRIES, the distinguished Dutch botanist, celebrated his eighty-fifth birthday on February 16.

DR. FRANK BURR MALLORY, until his retirement in 1932 professor of pathology in the Harvard Medical School, having reached the age of seventy years, has also retired as chief of the department of pathology at Boston City Hospital. Dr. Mallory has been connected with the hospital since 1891.

SIR ROBERT HADFIELD, metallurgical engineer, managing director of Hadfield's Limited, Sheffield, has been elected an honorary member of the Academy of Sciences at Leningrad, in recognition of his work for metallurgy. The Soviet Ambassador in London, I. Maisky, gave a luncheon in honor of the occasion on February 28.

Dr. Arthur E. Kennelly, emeritus professor of electrical engineering, Harvard University, was elected to membership in the International Committee of Weights and Measures at its meeting in Sèvres, France, at the end of January.

Professor Marston T. Bogert, of the department of chemistry at Columbia University, has been elected president of the Columbia Chapter of Sigma Xi to succeed Professor Donald E. Lancefield. Professor Harold W. Webb, of the department of physics, has become vice-president, succeeding Professor J. J. Morgan, and Professor Arthur W. Thomas, of the department of chemistry, has been named secretary-treasurer to succeed Dr. G. Marshall Kay. Membership in Sigma Xi was granted to 115 candidates, including 17 faculty members.

Dr. H. Ludendorff, director of the Astrophysical Observatory at Potsdam, has been elected president of the German Astronomical Society, to succeed the late Dr. Max Wolf, of Heidelberg.

Nature states that at the annual meeting of the British Royal Astronomical Society held on February 10, the following officers were elected: *President,* Professor F. J. M. Stratton; *Vice-presidents,* Sir Arthur S. Eddington, Mr. John Evershed, Dr. H. Knox-Shaw and Dr. W. J. S. Lockyer; *Treasurer,* Mr. J. H. Reynolds; *Secretaries,* Mr. W. M. H. Greaves and Dr. W. M. Smart; *Foreign Secretary,* Professor Alfred Fowler.

Dr. David Riesman has been elected professor of the history of medicine in the University of Pennsylvania, filling a newly established chair.

Dr. J. Henderson Smith, plant pathologist of the department of mycology at the Rothamsted Experimental Station, has been appointed head of the recently organized department of plant pathology, to succeed Dr. W. B. Brierley, now professor of agricultural botany at Reading University, formerly at the head of the department of mycology at Rothamsted.

Museum News reports that N. D. Riley has been appointed keeper of the department of entomology of the Natural History Museum (British Museum) in succession to E. E. Austen. H. G. Blair has been appointed deputy-keeper of the department. W. P. Pycraft has retired from the post of assistant keeper in the department of zoology of the Natural History Museum (British Museum).

According to *Industrial and Engineering Chemistry,* George P. Gray, for the past two years director of the California Soil Improvement Committee, has become associated with the Colloidal Products Corporation, San Francisco, to assist in the continuation of the company's research program on the investigation of spreaders and fixators in their relation to spray material.

John R. Hewett, editor of the *General Electric Review* for nearly twenty years, has retired because of ill health.

Dr. Gustav Zechel, of the department of anatomy of the College of Medicine, University of Illinois, has received a grant from the American Medical Association for the purchase of a microcinematographic apparatus which will facilitate his studies on the growth of malignant cells. Dr. Arthur Knudson, professor of biochemistry, and Dr. Lloyd H. Ziegler, professor of neuropsychiatry of the Albany Medical College have been allotted a grant for the study of the remote effect of rickets.

H. A. Bendixen, of Washington State College and Experiment Station, has received a grant from the Oberlaender Trust of the Carl Schurz Memorial Foundation, under which he will study problems of dairy manufactures and travel in Scandinavian countries, Germany and Russia for one year. During the year's leave of absence Dr. N. S. Golding, associate professor of dairying in the University of British Columbia, will serve in his place as associate professor of dairy husbandry.

Professor Knut Lundmark, director of the University Observatory, Lund, Sweden, has been spending several weeks studying the collection of nebular photographs at the Steward Observatory of the University of Arizona, and Dr. Sture Holm, of the Lund Observatory, has been spending two months on photometric investigations with the three-foot reflecting telescope of the observatory.

An Associated Press dispatch states that Professor Auguste Piccard is planning a balloon ascent to study cosmic rays in the stratosphere this summer, starting from the grounds of the World's Fair at Chicago, provided that arrangements for financing his ascent can be made with American balloon and metal manufacturers.

Sir Henry H. Dale, director of the National Institute for Medical Research, London, will deliver the Dohme Lectures at the Johns Hopkins Medical School on April 20, 21 and 22.

Dr. Curt Stern, of the Kaiser Wilhelm Institute for Biology in Berlin, delivered a lecture at the University of Kansas recently on "The Structure of the Chromosomes." He is now engaged in a tour as a speaker for Sigma Xi, honorary science fraternity. Following his address at the University of Kansas, he went to the University of Missouri.

DR. J. E. ACKERT, dean of the division of graduate study and professor of zoology and parasitologist at Kansas State College, Manhattan, addressed the Snow Zoological Club at the University of Kansas on February 21, on "Host-Parasite Relationships between Chickens and their Intestinal Nematodes."

DR. EDWARD MELLANBY, professor of pharmacology at the University of Sheffield, will deliver on June 8, 13 and 15 the Croonian Lectures on "Nutrition and Disease—the Interaction of Clinical and Experimental Investigations."

THE Romanes Lecture at the University of Edinburgh will be given this year by Dr. Heinrich Wieland, professor of chemistry at Munich.

THE Stuart McGuire Lectureship series at the Medical College of Virginia, Richmond, will be held on April 25, 26 and 27. Dr. Ronald T. Grant, of the department of clinical research, University College Hospital Medical School, London, will give three lectures on "The Pathology of Endocarditis" and a fourth lecture on "The Arteriovenous Anastomoses in Human Skin"; Professor Louis Hamman, of the Johns Hopkins University, will lecture on cardiac burgh will be given this year by Dr. Heinrich Wieversity, will hold a clinic.

THE second annual Sigma Xi Day of the Rochester Chapter was held at the University of Rochester on February 22. The principal event was the evening lecture, on "Lung Injuries of Industrial Importance resulting from Dust Inhalation," delivered by Dr. Cecil K. Drinker, head of the department of physiology at the School of Public Health, Harvard University. In addition, the program included a morning lecture intended especially for children, a series of seven lecture-demonstrations of current scientific research by members of the chapter and a formal dinner. "Light—Where it Comes from, Where it Goes" was the title of the children's lecture, given by Dr. Brian O'Brien, professor of physiological optics at the University of Rochester.

MEMBERS of the science faculty of Ohio University have organized a Sigma Xi Club. Officers elected for the current year are: *President,* Professor F. H. Krecker, head of the department of biology; *Vice-president,* Dr. F. B. Gullum, associate professor of chemistry, and *Secretary-treasurer,* Dr. D. B. Green, assistant professor of physics. Members are: Professors Paulsen, Anderson and Patrick, of the department of psychology; Professors Stehr, Rowles, Frey and Krecker, of the department of biology; Professors Morton, Reed and Starcher, of the department of mathematics; Professors Gullum and Clippinger, of the department of chemistry; Professors Heil and Green, of the department of physics, and Professor Clark, of the department of civil engineering. Meetings will be held bi-monthly throughout the year. The subjects of papers to be presented during the current year are: "Radio Thermy," "Principles of Biologic Control," "The Goal Gradient Process of Learning," "Concepts of Infinity," "A Study of Stresses in Arches by Means of Small Models," and "Relation of Clumping to Resistance to Toxic Substances in Invertebrates."

THE department of geology and geography of Northwestern University announces the continuation of its exchange arrangement with the University of Cincinnati, initiated last year. Early in March Dr. Nevin M. Fenneman, professor and head of the department of geology and geography, University of Cincinnati, gave four lectures at Northwestern University, and Dr. J. T. Stark, associate professor of geology, Northwestern University, will give a similar series of lectures at the University of Cincinnati. Professor Stark's lectures will deal principally with the geology of the Precambrian rocks of the United States and with the methods used in interpreting their structure and genesis; they will be delivered at Cincinnati during the week of March 20. The lectures given by Professor Fenneman dealt chiefly with problems of regional physiography. The subjects of these lectures were as follows: "The Middle Rocky Mountains," "The Appalachian Peneplains," "The Southern Rocky Mountains" and "The Grand Canyon District." In addition, Professor Fenneman spoke on the night of Thursday, March 9, before the Geological Society of Chicago on "Cyclic and Non-Cyclic Erosion."

ACCORDING to *Nature,* progress has been made in the discussion of the proposal to institute an international congress of the ethnological and anthropological sciences. Arrangements are now being made for a preliminary conference for further discussion to be held in Basel on April 20, 21 and 22. Invitations to the conference are being issued by the Royal Anthropological Institute of Great Britain, while the local arrangements are in the hands of Dr. Felix Speiser, director of the Museum of Ethnology, Basel. The conference will be welcomed on behalf of the City and the Education Committee, and its sessions will be held in the Burgeratsaal. The subjects for discussion are the scope of the proposed congress and its relation to existing congresses of like character, such as the International Congress of Americanists and the International Congress of Prehistoric and Protohistoric Sciences; constitution and procedure, and the date and place of the first meeting. On this last point, it has been suggested that meetings should take place in years alternate to those of the Prehistoric and Protohistoric Sciences Congress and coinciding once in every four years with the European meetings of the Americanists' Congress.

THE thirteenth annual summer term of the American School of Prehistoric Research will open in Prague on June 28, and close in Berlin on August 21. Dr. V. J. Fewkes, who last year conducted the expedition to Yugoslavia sponsored jointly by the school, the Fogg Art Museum of Harvard University and Peabody Museum of Harvard, will again be in charge as associate director for the summer term. The program will consist of a study of museum collections, field excursions, conferences, excavations (including field technique) and examinations. Requests for further information should be addressed to Dr. George Grant MacCurdy, director, Old Lyme, Connecticut.

THE department of biology of the College of the Pacific at Stockton, California, will open a Marine Biological Station on the Pacific Coast. Courses in elementary and advanced biology will be offered during the regular summer session. Students may spend three additional weeks at the station to carry out research in invertebrate zoology. Facilities will be offered for intensive laboratory work in biology and zoology. Student living quarters will be established close to the station at a low rate, and the cost of board will probably not exceed the amount charged at the college. It is hoped eventually to establish a permanent Pacific Biological Marine Station with courses continuous throughout the year.

Museum News states that the Adler Planetarium and Astronomical Museum, on Northerly Island, Chicago, will complete the lower floor and install additional ventilating machines in the next two months in order to take care of crowds expected at the time of the World's Fair this summer. In order to make the additions the planetarium is closed for the two months. During the fair lectures will be given every hour instead of twice a day.

Nature reports that Sir Dugald Clerk, who died on November 12, bequeathed £3,000 to the Institution of Civil Engineers; £2,000 to the Royal Society; £1,000 to the Royal Institution; £1,000 to the Royal Society of Arts; £1,000 to the Institution of Mechanical Engineers; £1,000 to the University of Glasgow; £1,000 to the University of Leeds; £1,000 to the University of St. Andrews; £1,000 to the University of Manchester; £1,000 to the University of Liverpool. The residue of the property is to be divided into thirty-one parts; three of these parts are to go to the Institution of Civil Engineers; two to the Royal Society; one to the Royal Institution; one to the Royal Society of Arts; one to the Institution of Mechanical Engineers; one each to the Universities of Glasgow, Leeds, St. Andrews, Manchester and London.

DISCUSSION

NATURE SANCTUARIES—A MEANS OF SAVING NATURAL BIOTIC COMMUNITIES

ONE of the characteristic things about organisms is their fluctuations in abundance from time to time. A community is an assemblage of plants and animals—a living thing which after a period of stress will never be exactly the same again. A nature sanctuary is a community or community fragment covering a certain area within which the fluctuations in abundance and other natural changes are allowed to go on unmodified and uncontrolled. Such areas afford opportunity for the study of the dynamics of natural biotic communities.

Outside of modern ecology there has been little or no tendency towards the development of specialists in the entire life of natural communities. The trend of research and education is toward specialization on particular objects or particular organisms. Perhaps one reason why nature study has been unsuccessful is because it is not the study of nature but of single natural objects or groups of objects which constitute a small part of any natural assemblage of organisms. Often this has resulted in the emotional protection of animals singled out by popular prejudice. In general, from a philosophical and practical view-point, the unmodified assemblage of organisms is commonly more valuable than the isolated rare species. However, because the significance of the unmodified assemblage is popularly ignored, the whole is commonly sacrificed in the supposed interest of the rare species. Usually neither need be sacrificed in any large natural area.

The nature sanctuaries are surrounded by areas in a less natural state, called buffer areas of partial protection. In a buffer area the vegetation is only slightly modified by man. It is a region of partial protection of nature and is zoned to afford suitable range for roaming animals under full protection. Since nature sanctuaries are areas in which natural forces are allowed free play, they may be classified with regard to the organisms now missing from the primeval community which once occupied the same area.

(1) First-class nature sanctuaries include areas of original vegetation containing all the animals which are historically known to have occurred there. (2) Second-class nature sanctuaries include (a) second growth areas approaching maturity with animals as in the first-class type and (b) areas of original vegetation from which not more than two important species of animals are missing. (3) Third-class nature

sanctuaries include areas modified to a greater degree than second-class ones.

(1) *Research reserves* of the National Park Service are essentially nature sanctuaries. They recognize two additional divisions of a park: (a) a greater part of the park open to the public and traversed by trails and roads, and (b) an area of development, hotels, etc. (2) *Natural areas* in the U. S. Forest Service sense are partial nature sanctuaries but primarily floral. (3) *Primitive areas* and *wilderness areas* in the U. S. Forest Service sense are primitive only in human transportation and conditions of living. Vegetation may be cut over and various animals wanting. (4) *Research area* and experimental area usually imply modification (except in the National Parks).

Except in desert and tundra, first-class nature sanctuaries are not available outside the national forest and national parks, and in rare instances in state and provincial parks. Buffer areas may serve as recreation areas, game reserves, etc. They are areas of partial protection not always available on all sides of natural areas. Reserve areas in the national parks and national forests are probably too small to serve as true nature sanctuaries. They have not been selected with reference to animals, and no buffer area of protection within which animals will not be disturbed is ordinarily set aside.

Nature sanctuaries are essential if any of the original nature in North America is to be saved for future generations for scientific observation of, among other things, the important phenomena of fluctuation in abundance of plants and animals, their social life, etc. Due to lack of knowledge of these fluctuations custodians view each change in abundance with alarm and desire to apply remedies immediately; hence, constant pressure must be exerted on government agencies to prevent the current popular idea of "control" and "improvement" from entering into the management of national parks, provincial and state parks and other reserves containing natural areas suitable as nature sanctuaries with buffer territories. The experiment of leaving areas essentially alone, which was so successful in a few of our parks, is worthy of repetition. In general much control activity is useless because it is applied to animals at their maximum abundance and barely hasten the natural decline.

The Ecological Society of America urges a subdivision of all but the small reserves into sanctuaries, buffer areas of partial protection and areas of development for human use where this is one of the aims of the reserves. A further aim of the society is to promote adequate scientific observation bearing on the fluctuations in abundance, to stimulate cooperation between the controlling agencies in charge of game and vegetation reservations in order that more logical units be developed and better methods of administration adopted.[1]

VICTOR E. SHELFORD
Chairman of the Committee for the Study of Plant and Animal Communities, Ecological Society of America.

THE WATER CONTENT OF MEDUSAE

MY accuracy has been questioned by Bateman,[1] who writes that "Gortner's statement that medusae contain 99.8 per cent. water is contradicted."

The statements which he criticizes are as follows:

> As I write these lines there lie before me two sheets of paper. One is the photograph of a large Medusa (jellyfish) from the Atlantic Gulf Stream which was photographed immediately after being removed from the water and being placed upon the open pages of a magazine. The Medusa, as removed from the water, weighed in excess of 500 grams. In the photograph one can read the distorted print through the more or less transparent outer portion of the umbrella, but the central portion of the Medusa which measured approximately 10 × 12 cm was sufficiently dense and opaque to prevent the print underneath from showing in the photograph.
>
> The other sheet of paper is the opened pages of the magazine upon which the Medusa had been allowed to dry after being photographed. These pages simply appear as though they had been wetted and then dried. No noticeable film is discernible on the surface of the pages. The print is clear-cut, and even exposing these pages to ultra-violet light results in extremely slight fluorescence. The weight of these pages exceeds by less than 0.45 gram the weight of the pages before the Medusa was dried upon them. Less than 0.10 per cent. of dried residue from the large Medusa including the salts, etc., in the adherent sea water and all of the inorganic constituents of the living organism![2]

In the discussion to this paper (p. 702) I pointed out that I was dependent upon the statement of the collector as to the weight of the living medusa, but that I had myself confirmed the dry weight, also that on other occasions I had personally made somewhat similar observations. In another connection I have stated that "in some instances, as in the case of the jellyfish, only an insignificant fraction of the organism is composed of organic material, as little as 1 per cent. of the jellyfish being organic matter."[3]

Bateman's flat contradiction of my statement rests, in so far as I can ascertain, on his acceptance of the data of Krukenberg[4] (who reports 4.60 per cent.

[1] Full details of nature sanctuary plans will appear in the society's official organ, *Ecology*, early in 1933.

[1] J. B. Bateman, "The Osmotic Properties of Medusae," *Jour. Exper. Biol.*, 9: 124–127. 1932.

[2] R. A. Gortner, *Trans. Faraday Society*, 26: 678–704. 1930.

[3] R. A. Gortner, "Outlines of Biochemistry," N. Y. (1929). *Cf.* pp. 227–8.

[4] C. F. W. Krukenberg, *Zool. Anzeiger*, 3: 306. 1880.

solids in *Rhizostoma cuvieri,* 4.20 to 5.80 per cent. in *Aurelia aurita* and 3.70 to 4.25 per cent. in *Chrysaora hyoscella*) and the observations of Moebius[5] (who reports 2.06 to 2.10 per cent. in *Aurelia aurita*), and the non-acceptance of my data. It is somewhat surprising that Bateman does not report independent data of his own, since he used a large *Cyanea* in his own studies.

Unfortunately, I can not designate the species for which I have personal data, since no zoologist was available at the time the organism was secured. A photograph of the organism as secured, and as later dried down on a sheet of paper 23 × 30 cm has, however, been published.[6] This medusa was not *Gonionemus* sp., as Bateman erroneously assumes. In no place have I made any statement as to the water content of *Gonionemus.* Perhaps I am in error in wording my statements so that they might be interpreted as applying to all medusae, but I have said "a medusa,"[2] "one species of jellyfish (*medusa*),"[6] "the organism may contain," etc., and have recognized that the physiological condition of the organism, *e.g.,* presence of egg masses, etc., may make for a higher solid content. However, I still believe, from my own observations, that some salt-water medusae have a water content exceeding 99 per cent. and hope that investigators having access to such material will reinvestigate this question, for it is those organisms with the low solid content which present the interesting physiological problems.

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THE PHYSIOLOGICAL BASIS OF THE TWISTING HABIT IN PLANT GROWTH

IN connection with the interesting paper of Dr. William Seifriz in a recent number of SCIENCE[1] on the spiral habit of growth, correlated with the twisting of the stem or trunk of many plants, considered as a result of physiological rather than environmental conditions, it was thought that it might be of interest to add a bit of evidence which has been obtained in this laboratory.

In the course of an experimental program on the genetic effect of x-rays, an investigation has been undertaken of the physiological abnormalities of seedlings of the citrus fruits grown from irradiated seed. It is hoped at a later time to publish the results in full, but two seedlings are of interest at the moment. From the time of sprouting, these young plants showed a decided tendency to spiral in a counterclockwise direction. Both plants twisted so markedly that the trunk was bent from the vertical and the leaves, during early life, were crushed against the stem. After six months the habit was abandoned, and the later growth was normal. Both plants showed some evidence of tissue inversion and other characteristic x-ray injuries during early life.

The seeds used in the work were obtained from a citrus experiment station, and represented a normally quite stable seed bed stock. Before treatment, they were soaked in distilled water for fifteen minutes and left in a moisture-saturated atmosphere for twelve hours. They were then dried on filter paper and were given doses of 2,400 roentgens of radiation from a thick-walled tungsten-target Coolidge tube operated at 200 k.v.p. and 30 ma. current. The seeds were then planted in flats in a mixture of sand and peat moss and maintained in a greenhouse, protected from wind and from sharp temperature change. Since the source of light was the sun, since undue mechanical shock was avoided for the seedlings, and since but two of the entire group showed any tendency to twist, it seems logical to assume tentatively that in this case a typical spiral growth, resulting in extreme twisting of the stem in a developing tree, was the result of a physiological rather than an environmental condition —possibly x-ray induced abnormal mitoses.

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AN UNUSUAL CRETACEOUS CIRRIPED

THE decision of the International Commission on Nomenclature (Opinion 118) that *Scalpellum gabbi* Wade[1] is a *nomen nudum,* on account of the extremely cautious wording of Wade's account of it, seems to make some further action necessary to place this rather unusual barnacle on a satisfactory basis. Wade figured the carina and an upper lateral plate. These are not known to belong to one individual, and it is even possible that they do not belong to the same species; but it happens that the carina was selected by Charles Darwin as the essential plate in diagnoses of fossil species of Scalpellum, most of which are known by detached plates. Wade's figures of the carina are ample for the recognition of the species, which is quite peculiar among Cretaceous forms for the subcentral position of the umbo. Only four other Cretaceous species, all European, have this advanced form of carina. It may be doubted whether Scalpellum developed this type of carina so early, and it may turn out that these Cretaceous species belong to

[5] K. Moebius, *Ibid.,* 5: 586. 1882.
[6] R. A. Gortner, *Gamma Alpha Record,* 22: 42. 1932.
[1] SCIENCE, January 13, 1933.

[1] U. S. Geol. Surv. Professional Paper 137, p. 191, plate 62, figs. 3, 4, 6, 7.

the less evolved Smilium group, a question which can be settled when specimens are found with plates in place. I propose to restrict *Scalpellum gabbi* Wade to the carina represented in his plate 62, figs. 3 and 4. The figures are inverted.

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STREAM DOUBLE REFRACTION EXHIBITED BY JUICE FROM BOTH HEALTHY AND MOSAIC TOBACCO PLANTS

IN previous papers[1,2] we reported that juice from tobacco plants infected with tobacco mosaic virus exhibits a stream double refraction characteristic of sols containing rod-shaped particles. Juice from healthy tobacco plants did not show double refraction. The juice was always obtained by freezing the tissues, followed by thawing, pressing and centrifuging.

Since the publication of these results we have found that centrifuged juice from unfrozen, macerated, healthy leaves regularly exhibits stream double refraction, and juice pressed from healthy tissues which have been frozen, thawed and pressed may sometimes show stream double refraction if uncentrifuged.

After juice from unfrozen, macerated, healthy tobacco leaves was subjected to Vinson's[3] safranin–Lloyd's reagent treatment for purifying tobacco mosaic virus—the purified preparation failed to show stream double refraction; however, purified virus from unfrozen mosaic leaves exhibited strong stream double refraction and, like the unpurified virus, could usually be diluted with 200 parts of water before double refraction disappeared. These results apparently indicate that all the detectable doubly refractive material was removed from the healthy juice, but that none was removed from the infective juice by the purification treatment, and suggest the possibility that much or all of the doubly refractive material in the juice from diseased plants may be different from that in juice from healthy plants. However, the present evidence is insufficient to warrant conclusions as to whether the virus particles are or are not responsible for all or part of the double refraction exhibited by juice from diseased plants.

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[1] *Proc. Soc. Exper. Biol. Med.*, 30: 155–157, 1932.
[2] SCIENCE, 77: 26–27, 1933.
[3] *Phytopath.*, 22: 29, 1932.

SCIENTIFIC BOOKS

Principles of Genetics; A Text-book, with Problems. By E. W. SINNOTT and L. C. DUNN. McGraw-Hill Book Company, New York. Second edition, xvi + 441. 1932. $3.50.

Recent Advances in Plant Genetics. By F. W. SANSOME and J. PHILP, with foreword by SIR DANIEL HALL. P. Blakiston's Son and Company, Philadelphia. x + 414. 1932. $4.00.

THE two publications cited above are of interest from the light they throw upon the rapid evolution of genetics within recent years, entirely apart from the information which they may lay before the student. It was not so long ago that genetics was concerned chiefly with 3 : 1 ratios or modifications of such ratios. The original concept of the gene was independent of its location in the chromosome and the intimate behavior of chromosomes was of relatively little interest to geneticists. Cytologists seemingly had tired of working out the alteration of generations in lower forms and the relatively few who remained in the field of cytology appeared interested in the structure of chromosomes and their behavior in nuclear division without much concern as to what differences in structure and behavior mean to the organism and its offspring. A change has taken place in the attitude of geneticists toward cytology which has been especially marked within the last half dozen years. Chromosomal behavior has become the foundation upon which modern genetics is now being built as is shown by the two texts under review.

The American text by Sinnott and Dunn is a revised edition of their 1925 publication. Two new chapters have been added, one on the contribution of genetics to evolutionary theory, and one on the relation between genetics and development. The chapters on the application of genetics in plant and animal breeding, on inheritance in man and on the problems of eugenics have been eliminated. The treatment of biometric methods has been rewritten by D. R. Charles and placed in an appendix. Among the topics which have received new or extended treatment may be mentioned the induction of mutations by radiation; recent analysis of chromosomal changes; segmental interchange between chromosomes; the cytological demonstration of crossing-over; mapping of genes in chromosomes by cytological methods; chromosomal and genic balance; and the physiological interpretation of the facts of heredity. At the end of each chapter are given a dozen or more reference problems aimed to stimulate the student in extending his grasp of the subject under discussion by study of original sources

in the literature. In addition there is in the appendix a list of over 400 problems based on the text, a large proportion of which demand calculations from data presented. The problem method seems to have met with success at the hands of the authors since the number of problems given is increased over the earlier edition. They should help the student to a more thorough grasp of the subject as is the case with "original" problems in text-books of geometry. They should thus make teaching easier for most teachers. It would not be surprising, however, if a demand should have arisen for a set of answers to be sold only to teachers as has been the case with the problems in texts on mathematics. The authors are recognized investigators and experienced teachers in the adjoining fields of botany and zoology. Their association in the Connecticut Agricultural College as well as more recently in Columbia University has given them an experience and sympathy in applied as well as in fundamental problems of their subject. As one would expect, their text has profited by their experience and appears to be a well-organized and balanced treatment of the principles of genetics which is presented in a form admirably adapted to the classroom.

The English publication by Sansome and Philp is a marked contrast to the American text. Its scope and manner of presentation is not adapted to the generalized undergraduate course in genetics. It is intended, however, primarily for the teacher and the research geneticist and by them will be found a valuable and stimulating book. Its title would suggest that the organisms discussed are plants only. This is in the main true, but a treatise on plants could not be good genetics if it gave no reference to Drosophila, which the authors apparently classify as a banana plant product. The subject-matter is further restricted to the more recent advances in plant genetics; those mainly of the last ten years. A balanced treatment even of this limited period is not attempted and certain topics such as sex, chimeras and the mathematics of inheritance and populations receive little or no consideration. The main purpose appears to be to acquaint the reader with the last words about chromosomes in relation to genetics. In some cases the last word literally had not yet been spoken since there are frequent references to papers in press. The authors might well have had added the subtitle "Chiasmotypy and its effect upon genetic phenomena," since much space is given to this still rather controversial theory. There can be no doubt, however, of the importance to geneticists of an understanding of the early stages in the reduction divisions. This has been hitherto largely a *terra incognita*. Fortunately, it is beginning to be explored through direct cytological observation and we are no longer confined to genetic evidence as to what has happened at this stage. Polyploidy and segmental interchange are discussed in considerable detail, especially in relation to the species problem.

The difference in view-point between the American and the English books may be seen by a couple of examples. Sansome and Philp devote eight pages to the various hypotheses advanced by different investigators to account for speltoid wheats and fatuoid oats because they obviously are a chromosomal problem tied up in some way with the polyploid nature of these species. These abnormal types are apparently not mentioned by Sinnott and Dunn, probably because they felt it wiser in presenting the principles of genetics in a text-book to concentrate upon the phenomena about which there was general agreement. In the English book there is an extensive bibliography of 47 pages placed in convenient position for reference at the end of the text. In the American book the citations are fewer in number and grouped at the end of the chapters to which they refer. This arrangement is doubtless an advantage for the student working over the pages for the first time but is inconvenient for general reference.

The English book is an outgrowth of the association of the two authors in the John Innes Horticultural Institution. It is only a dozen years ago at the Toronto meeting of the A_3S, that the leader of this institution denied that we had any knowledge of how species have arisen in nature, though he expressed the belief that any day the mystery of species might be solved. Bateson was the godfather of modern genetics and outstanding as a leader in genetic thought but, although at Toronto he confessed his conversion to belief in chromosomes, like so many of his day he never really came to think of genetic problems primarily in terms of chromosomal behavior. It is of interest, therefore, to see the John Innes Institution taking such a leading part in making chromosomes and their activities the basis of modern theories in genetics. In the book discussed, which in no small measure is an embodiment of recent investigations at this institution, the formation of new species in a number of plants has been shown to be a relatively simple chromosomal phenomenon.

The book is not a text for elementary students since it treats in large measure of unsettled problems and is not easy reading. It is a useful publication, however, and can be recommended strongly to advanced students and research workers since it brings together the most recent investigations in the modern field of cytogenetics.

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SPECIAL CORRESPONDENCE

THE SIXTH MENDELEEV CONGRESS AT KHARKOV

ONE of the largest gatherings of chemists that have ever taken place was witnessed recently at Kharkov, capital of the Ukraine Soviet Republic, where some 3,000 chemists, from different parts of the U. S. S. R., and several foreign guests met at the sixth Mendeleev Congress. Since the death of the great chemist, the congress bearing his name has been held on an average of every three years. The last one met in Kazan in 1928, and the next in 1934 will coincide with the centenary of the work of the famous founder of the periodic table of elements. It will take place in Leningrad at the same time as the proposed international congress of pure and applied chemistry and will give an opportunity to many European chemists to become acquainted with their Russian colleagues.

The Kharkov Congress differs from similar gatherings in the division of its organizations into "columns" and "brigades," each studying some special problem in connection with the second Five Year Plan. Side by side with classical divisions into biochemistry, electrochemistry, colloid chemistry, there were special sections dealing with catalysis, raw materials (organic and mineral), chemical equipment, plant control, etc.

The first three days were devoted to general surveys in the more important subjects and to a review of the relations between chemistry and socialist reconstruction by Zatonski, formerly professor of physical chemistry and now an important figure in the Ukrainian government. Later the congress divided into columns and brigades. The outcome of their discussion was embodied in a number of resolutions, which were organized and coordinated by another smaller conference to be convened in Moscow on December 1 and will serve as a basis for development of the chemical program of the second Five Year Plan.

There were upward of five hundred reports presented at the congress, which makes it impossible to deal even superficially with their subject-matter. The titles of the papers read at the general meetings will indicate the range of the subjects covered: "The Application of Wave Mechanics to Chemical Problems, Including Recent Theories of the 'Spinning' Electrons," by George Roumer; "Electrostatic Theories of Valence," by G. K. Carkin; "The Structure of Complex Compounds," by T. A. Kazarnovski; "The Theories of Catalysis," by B. Roginski; "The Theories of Adsorption," by A. Frumkin; "Chemistry and Metallurgy," by E. I. Orlov; "Utilization of Raw Materials," by A. C. Fersman; "Chemistry and the Harvest Problem," by K. N. Sokolovski, and "Chemical Equipments," by S. L. Schipkin.

As examples of specific discoveries in the field of applied chemistry, one may mention the interesting researches of Madame Yermolyeva, of the Bach Institute of Biochemistry (Moscow), who found that traces of certain ferments obtained from decomposing bacteria will act as preservatives for caviar. These ferments have certain or all the properties of the bacteriophage, since they are able to destroy bacteria and to liberate more ferments in so doing.

A new process in aluminium technology, depending upon the special condition existing in the U. S. S. R., where petroleum refining and aluminium metallurgy can be developed side by side upon a large scale, has been worked out by E. A. Kazanovski (Moscow). It depends upon the production of aluminium chloride by the action of chlorine on impure bauxite or upon kaolin; the resulting chloride is used as a catalyst in the cracking of petroleum. From the residue on the cracking process one may recover hydrochloric acid and eventually regenerate chlorine, while the remaining bauxite is electrolized to give metallic aluminium.

An achievement to which Russian chemists point with pride is the manufacture of synthetic rubber from alcohol, the latter being obtainable from sawdust. An exhibition of chemical products, which was held at Kharkov at the time of the congress, included many objects from synthetic rubber (tires, goloshes, tubing, etc.) side by side with others made from the usual natural rubber and from rubber obtained from the roots of the Caucasian plant Tau-Saghiz (*Scorzonea Saghiz*). There were other exhibits showing various raw materials and also dyestuffs and pharmaceuticals, indicating a distinct advance in Russian fine-chemicals manufacture.

The congress was mainly remarkable because of the great interest shown in its proceedings not only by the participating chemists but also by the general public. This was due largely to the publicity given to technical matters in the Soviet press.

A number of foreign guests attended the conference. These included Dr. R. E. Liesegang, of Frankfurt, Professors Kurt Hess, Pitch and Klages, of Berlin, Dr. Giacomo Fauser, of Italy, Professor N. C. Greenwood, of Melbourne, Australia, Dr. V. Cofman and J. G. Crowther, London. The guests were presented with a beautiful set of photographs of eminent chemists, excursions were organized to the newly built dam on the Dnieper and the extensive electrochemical plants for the manufacture of aluminum, steel, etc., which are nearing completion, and most of the foreign chemists remained to witness the brilliant November celebration in Moscow.

VICTOR COFMAN

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

IMPROVING THE STAINING ACTION OF IRON HAEMATOXYLIN

IRON haematoxylin, the most useful stain available to the cytologist, has during the past few years caused a great deal of trouble for a number of microscopists through its erratic behavior. Sometimes the desirable crisp black and white contrasting stain would be obtained, but more often it was not. The cytoplasm would retain the stain with the resulting muddy appearance seen all too often of late years. Stock solutions became turbid and lost their staining action in a few weeks.

Three years ago it occurred to the writer that if neutral solutions were essential to blood stains, neutrality might be a factor in the successful use of iron haematoxylin. Our distilled water was known to be slightly acid (about pH 6.6). A trace of sodium bicarbonate was added to a fresh 0.5 per cent. solution of haematoxylin. The straw-colored solution changed at once to the rich dark red wine color recognized as typical for an aged sample of this stain. Sections stained in this solution differentiated perfectly.

This 0.5 per cent. solution remains clear for about six months or occasionally longer and stains well as long as it is clear. These results have been obtained equally with haematoxylin crystals of pre-war Gruebler make or with the recent C. P. product of McAndrew and Forbes of America. After a solution of 0.5 per cent. haematoxylin becomes turbid the staining action is uncertain and the solution should be discarded. Even though six months should mark the functional life of the solution this does not seem serious in view of the successful behavior of the stain during this period.

Inasmuch as there appears to be a rather wide latitude in the quantity of bicarbonate that may or should be added to the solution of stain, it has not seemed worth while to determine the exact quantity added nor the pH obtained. In practise, to a liter of solution a very small quantity of sodium bicarbonate is lifted on the point of a scalpel and dropped into the solution. This rule of thumb procedure has never failed to work, although the quantities of alkali added must have varied considerably.

The making of a 0.5 per cent. solution is greatly facilitated by preparing (according to the directions given in Kingsbury and Johannsen's "Histological Technique") a 10 per cent. stock solution of haematoxylin dissolved in 95 per cent. alcohol. This solution keeps indefinitely and 5 cc of it in 100 cc of water gives a staining solution of the proper strength. To this solution the sodium bicarbonate is added.

This procedure has been in use for three years in this and neighboring laboratories and has given uniform results.

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A DEVICE FOR MOUNTING ANATOMICAL PREPARATIONS

A SIMPLE and convenient method for mounting anatomical preparations is as follows: A plate is made by melting hard paraffin and pouring it into a form (as a box top, etc.) where it hardens to form a plate from one fourth to one half inches in thickness. During the process of melting, enough lampblack is added to give the mixture a deep black color, which is, of course, an advantage where a dark background is desired. To prevent curling of plates after immersion in preservative, two glass rods are embedded parallel to each other, one on each side of the plate, just before the process of hardening is begun. These rods may be of various diameters, but we have found that those from 5 to 8 mm in diameter are quite satisfactory. The length of the rods will depend upon the length of the plate as they are placed lengthwise within the plate (Fig. 1 a a). Before the rods

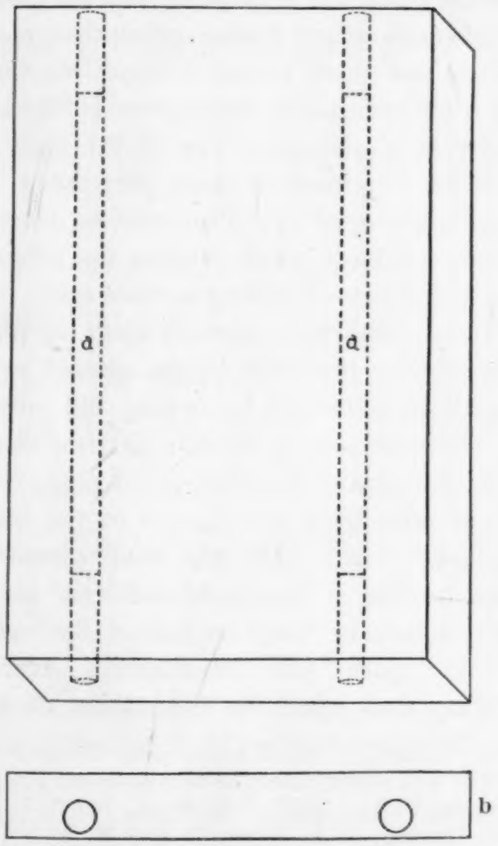

FIG. 1

are dropped in the melted paraffin a loop or two of heavy twine is wrapped around each end of each rod so that the rods will be suspended near the middle of the plate after it hardens (Fig. 1 b). Care must be taken to smear the inside of the box form with glycerine so that the hardened plate can be removed easily from the form.

The addition of some beeswax and resin to the paraffin-lampblack mixture will increase to a considerable extent the rigidity of the plate, although these constituents are not absolutely necessary.

Before the plate has hardened, and is still plastic, the anatomical specimen is pressed down slightly into the soft plate to hold it in position and is fastened there with thread looped around the parts of the specimen, passed through holes, and tied at the back of the plate. Necessary labels are now attached.

When completed, the preparation is immersed in a preservative in a museum jar. Such preparations will last for an indefinite time.

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SPECIAL ARTICLES

THE PARTICLE SIZE OF THE VIRUS OF EQUINE ENCEPHALOMYELITIS

A MOST interesting epidemic of acute encephalomyelitis occurred among horses and mules in various local districts of California during the summer and fall of 1930, 1931 and 1932. Bacteriological and pathological studies of the disease were conducted by Meyer, Haring and Howitt and these workers have reported elsewhere[1,2,3] the salient characteristics of the virus and its effects on animals. In this work they recorded the filterability of the virus through Berkefeld V and N candles. However, filtration experiments utilizing the usual forms of candles, furnish no adequate basis for estimating the particle size of the virus because many factors other than mechanical sieve action have been shown to condition the filterability of a microorganism through such filters.

In order to obtain some idea of the virus particle size filtration experiments were performed with the acetic collodion gel ultrafilter series described by Krueger and Ritter[4] which possess the advantage of uniformity and low adsorbing surface area. The pore sizes of these membranes depends upon the percentage of nitro-cellulose dissolved in the glacial acetic acid and have been estimated by testing the permeability both to colloidal sols of known particle size and to water under certain standard conditions. The two methods of estimation give figures of the same order of magnitude with a relatively small constant difference between them. Manegold and Veit[5] have shown that this difference may be materially reduced by basing the pore size calculations from water permeability data upon the assumption of a random pore distribution as contrasted to parallel capillary bundles such as we had assumed to exist in the membranes. The result is a practical coincidence of the two pore size curves.

During the past year and one-half we have used different materials in making the membranes and have made minor alternations in the technique of preparation. The pore sizes of the series necessarily

ULTRAFILTRATION OF SUSPENSIONS OF ENCEPHALOMYELITIS BRAINS

No.	Dilution of original supernatant from 20 per cent. brain suspension	Per cent. collodion (Ultrafilter)	Bacterial cultures from filtrate	Animal inoculation filtrate
1	Undiluted	3.0	0	Typical disease
2	Undiluted	3.0	0	Typical disease
3	1: 2 with saline	3.0	B. subtilis	Typical disease
4	1: 2 with saline	3.0	B. subtilis	Negative
5	Control undiluted	Unfiltered	0	Typical disease
6	Control 1:2 with saline	Unfiltered	0	Typical disease
7	1:2 with broth	3.0	0	Typical disease
8	1:2 with broth	3.0	0	Typical disease
9	Control undiluted	Unfiltered	0	Typical disease
10	Control 1:2 with broth	Unfiltered	0	Typical disease
11	Undiluted	4.0	0	Negative
12	Undiluted	4.0	0	Negative
13	Control, undiluted	Unfiltered	0	Typical disease
14	Control, undiluted	Unfiltered	0	Typical disease
15	Undiluted	3.5	0	Negative
16	Undiluted	3.5	0	Negative
17	Control, undiluted	Unfiltered	0	Typical disease
18	Control, undiluted	Unfiltered	0	Typical disease
19	1:2 with broth	3.5	0	Negative
20	1:2 with broth	3.5	0	Negative
21	Control, undiluted	Unfiltered	0	Typical disease
22	Control 1:2 with broth	Unfiltered	0	Typical disease

[1] K. F. Meyer, C. M. Haring and B. Howitt, "The Etiology of Epizootic Encephalomyelitis of Horses in the San Joaquin Valley, 1930," SCIENCE, 74: 227–228, 1931.

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have had to be re-determined and do not correspond to the previously reported series. A description of the present membranes will be reported elsewhere.

In the present experiments the test material used was a 20 per cent brain suspension in normal saline freshly prepared from guinea-pigs which had been killed at the height of the disease. The suspension was centrifuged at low speed to remove coarse tissue particles and was then filtered under low negative pressures through sterile membranes of various pore sizes. The filtrates were tested for the presence of the virus by inoculating 0.3 cc. intracerebrally into guinea-pigs.

The table appended shows that the virus traverses a 3 per cent. membrane but is retained by a 3.5 per cent. membrane. The usual bacteriological tests for the detection of microorganisms were applied to the filtrates with negative results. Our data would indicate an approximate particle size of 500 μμ for the virus as it exists in brain suspensions. Under like conditions of preparation and filtration it is of the same order of magnitude as the causal agent of poliomyelitis[6] an analagous disease of man and is apparently ten times the size of the hoof and mouth disease virus particle.[7] Dilution does not appear to render the virus more finely dispersed, as by elution from carrier particles for example, nor to affect the filter pore surfaces so that the particles pass more readily.

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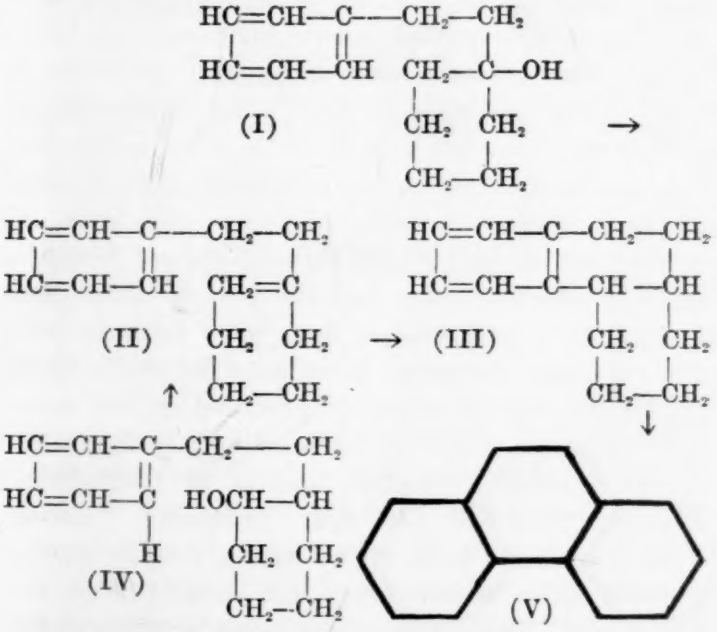
A NEW PROCESS FOR THE SYNTHESIS OF PHENANTHRENE AND OF PHENANTHRENE DERIVATIVES

FOLLOWING up the researches on ionene lately communicated,[1] Davidson and Perlman have now succeeded, in these laboratories, in applying the knowledge gained in the ionene field to the development of a new process for the synthesis of phenanthrene and of its derivatives.

By the well-known Grignard reaction, 1-phenethylcyclohexanol-1 (I) was prepared from phenethyl magnesium bromide and cyclohexanone. When this tertiary alcohol (I) was treated with concentrated sulfuric acid, it split out a molecule of water and condensed to the same octahydrophenanthrene (III) as Bardhan and Sengupta[2] obtained from 1-phenethylcyclohexanol-2 (IV), and like it gave a good yield of phenanthrene (V) when dehydrogenated by heating with selenium.

Bardhan and Sengupta appear to assume a direct cyclodehydration between the OH of the alcohol and an H of the benzene nucleus. But, as we have shown in the ionene group (see the above reference), such condensations may proceed rather through the formation of the olefin first, which then rearranges by cyclization. That this is the case here also, Davidson and Perlman have now proven by heating the alcohol (I) for one minute with 50 per cent. sulfuric acid, when the olefin (II) was obtained. The same olefin was prepared by distilling the alcohol with a crystal of iodine. Treatment of this olefin with concentrated sulfuric acid rearranged it to the octahydrophenanthrene (III). These reactions indicate that the structure of the olefin is that shown in the formula (II), and that such an olefin could be formed by dehydration of either our alcohol (I) or that of Bardhan and Sengupta (IV). If this is really the mechanism of the condensation, as we believe it to be, it is clear why the same octahydrophenanthrene results whether the OH on the cyclohexane nucleus is in Position 1 (I) or 2 (IV).



We believe that this synthesis has certain advantages over that of Bardhan and Sengupta, in that it starts with a simpler initial material, cyclohexanone instead of the potassium derivative of its ethyl carboxylate, and involves fewer steps. The investigation therefore is being extended in various directions, by using other carbonyl compounds in place of cyclohexanone and and other Grignard reagents instead of phenethyl magnesium halides.

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THE FORMATION OF SEMI-TRANSPARENT MEMBRANES FROM CULTURES OF SLIME-PRODUCING MICRO-ORGANISMS

THIS article presents a brief description of a procedure developed at this laboratory for the successful production of semi-transparent sheets resembling parchment from cultures of slime-forming micro-organisms.

The investigations of Beijerinck[1] and Harrison[2] have made important contributions to fundamental knowledge of the viscous fermentations. These authors considered an appreciable number of causal species and described the formation of specific slimy materials. As a result of this work, attention has been directed to numerous groups of slime-forming bacteria, including the levulan-forming types, the producers of dextran, the cellulan-yielding group and those forming the nitrogenous slimes or mucins.

Concerning the class of nitrogenous slimes, stringiness in cultures of marine bacteria (Sanborn[3]) was developed to a degree of cohesiveness which permitted the drawing out of the slimy substance into fine, continuous filaments. Preliminary experiments showed that, with the aid of a coagulating bath, it was possible to convert these filaments into flexible threads. While such films proved to have little economic value, the results obtained were sufficiently arresting to justify the investigation of other slime-forming groups along similar lines.

In a recent article on the microorganisms involved in the formation of pulp and paper mill slimes, the author[4] has emphasized the filamentous and yeast-like fungi in addition to the bacterial groups. The slimes formed by this diversified flora were heterogeneous, and variously designated to indicate the major types. Of all the viscous materials produced in the carbohydrate media provided, the gelatinous, cellulose-like masses formed by certain species of Oidium and Monilia, possessed the most promising qualities. These organisms built up abundant, doughy surface growths which became tough and leathery after several weeks. Development was rapid in glycerol and potato decoction, resulting in the formation of thick, rubbery mats in the shallow layers of this medium. Dextrin or glucose may be substituted for glycerol.

The growths were collected and subjected to treatments, the purpose of which was to convert the slimes either into strands or into comminuted masses. The material could then be brought into uniform suspension and deposited upon the sheet-forming substratum. The formation of the sheet, due, in all probability, to the coalescence of the slime particles, was readily achieved. In one case the material was digested in zinc chloride and regenerated in the form of strands, in water. According to the other method the growth was comminuted directly by agitation, without digestion. This more direct procedure, now employed exclusively, yielded sheets of lighter color and greater transparency than could be produced by the former method.

Immediately following their formation, the sheets were treated with a lubrication emulsion to give them flexibility, resilience, and sizing qualities. The process was completed by drying in a steam hot plate sheet dryer. A more complete account of these slime sheets will occur in a later article.

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